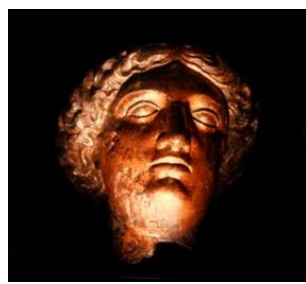# MINERvA: Introduction

Debbie Harris and Kevin McFarland
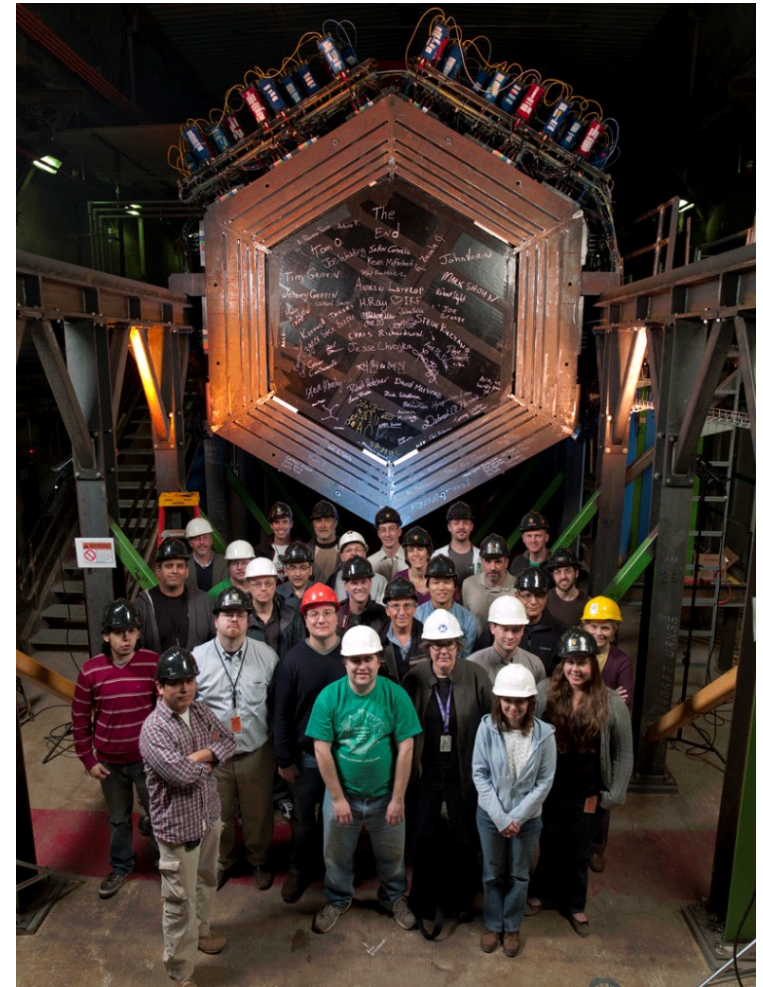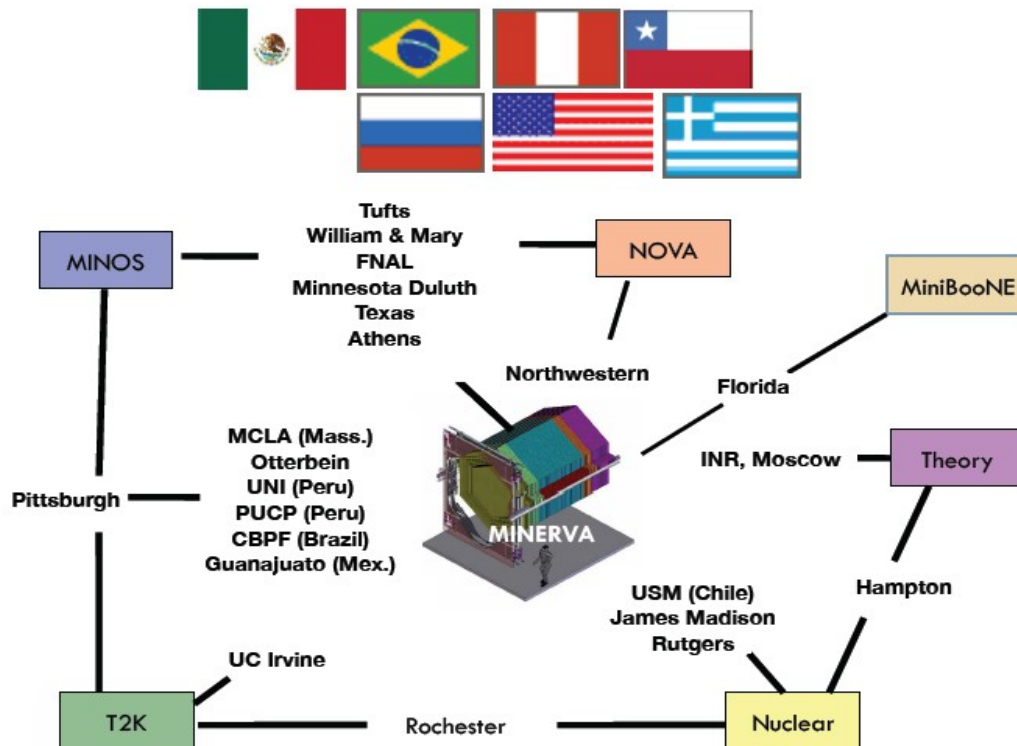9 August 2010
Briefing with Directorate
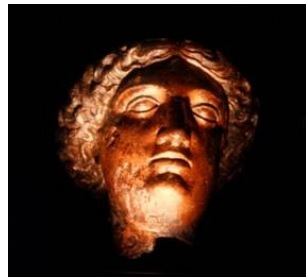
MINERvA collaboration

- ## MINERvA is ~80 physicists

  - 1/4 from groups with strong ties to Jefferson Lab program

 - Leading roles in construction, calibration, analysis, governance

Goals of Particle Physics

- Determining the fundamental particles and interactions found in nature

- Understanding how those blocks work in extreme cases to develop underlying theory of interactions
  - Strongly interacting (non-perturbative) regimes and finite temperature

- Applying those theories to explain phenomena in the Universe from their microphysical origins

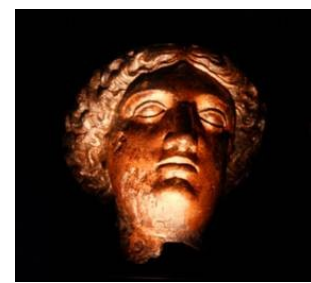# MINERvA and These Goals (1)
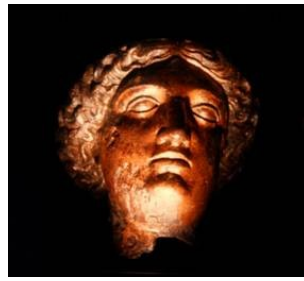
- Example: Leptons
  - Fundamental building blocks: neutrinos
  - MINERvA serves as engineering run for understanding mass splittings and mixing angles of neutrinos
  - Far-reaching consequences
    - Leptogenesis
    - Large scale structure of the universe
    - Nucleosynthesis

MINERvA and These Goals (2)
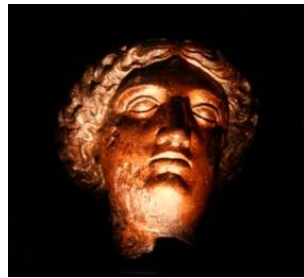
- Example: Strong Nuclear Force
  - Fundamental building blocks:
    - quarks, gluons (perturbative QCD)
    - baryons and mesons (elastic scattering off protons)
  - Successful description for both regimes, but...
    - don't know how to go from quark-gluon picture to baryon-meson picture
    - Can't put either picture inside a nucleus
  - Need suite of measurements to guide the theory
    - As always, we are limited to looking under "lamp posts" where our technology allows us to make measurements
  - MINERvA provides a new set of streetlights
    - Exclusive channels that probe different aspects of nucleus using the axial current
    - Comparisons of reactions on different nuclei

MINERvA's Nuclear Targets

- ● 5 solid targets of varying composition: C, Fe, Pb
   - – Target design optimized for reconstruction ability
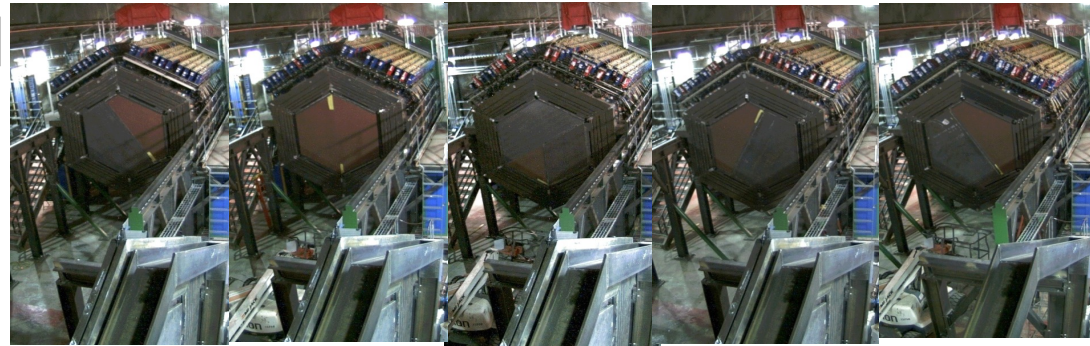
- ● 2 Liquid Targets: He and H_2O

- ● Neutrino Event Statistics on Different targets:
    - – 4E20 POT
    - – GENIE neutrino event generator
    - – Before detector acceptance applied

| Target	ANY	CC	CCQE	CCQE truth	NC	CCCoh	NCCoh
1	175000	132000	35000	21000	43000	580	280
2	175000	132000	35000	21000	43000	360	280
3	149000	110000	27000	17000	38000	640	400
4	66000	50000	13000	8000	16000	60	60
5	87000	65000	17000	10000	22000	260	60
Tracker	1849000	1367000	287000	189000	482000	11000	6000
Total	2501000	1856000	414000	266000	644000	12900	7080

MINERvA Introduction

Nuclear Target Events
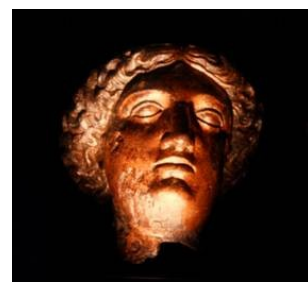
- Targets are passive, but surrounded with active tracker to allow projection into the targets
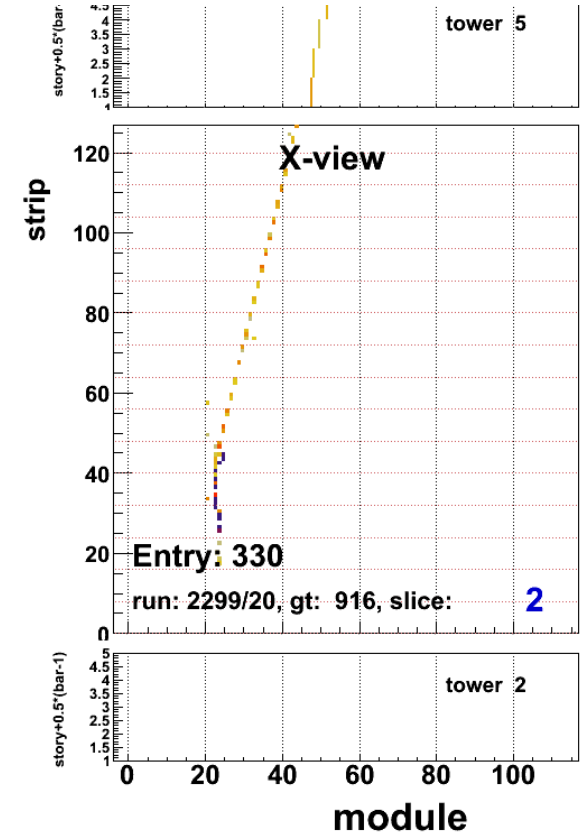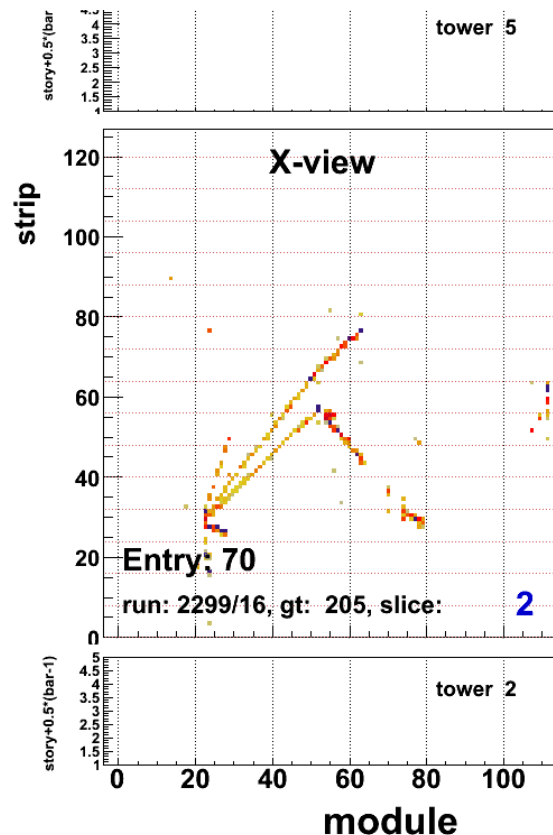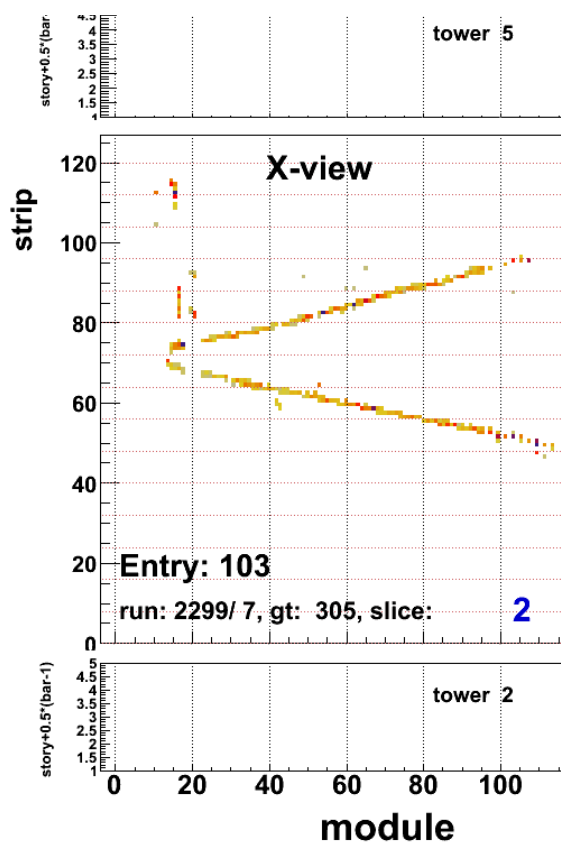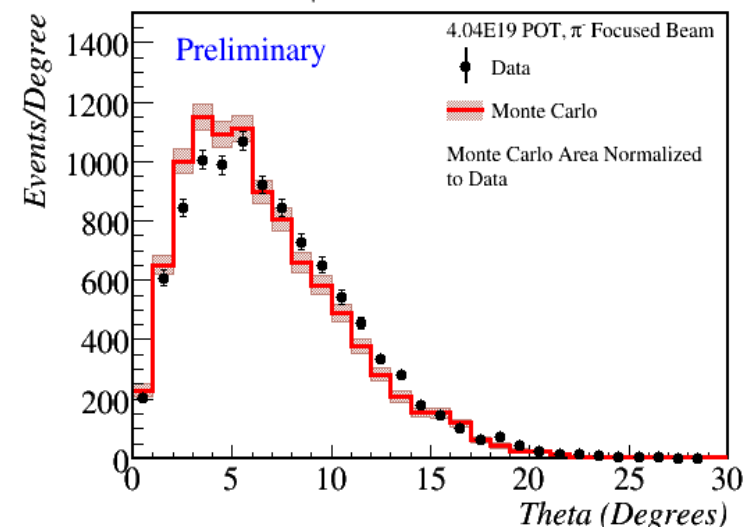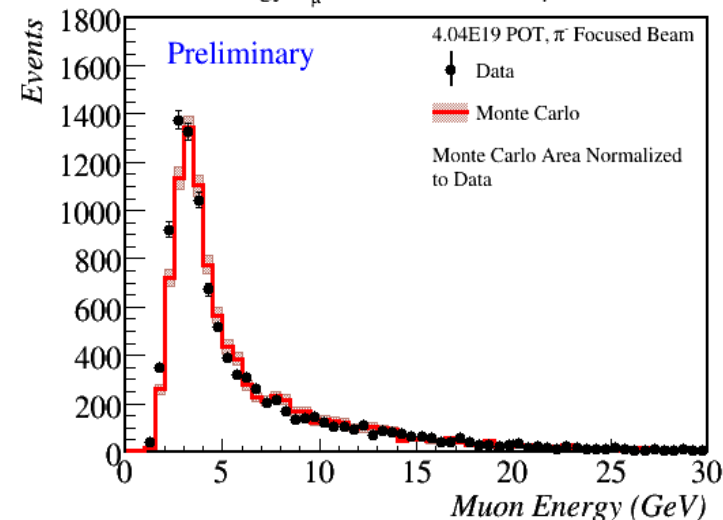
Status of Data Analysis
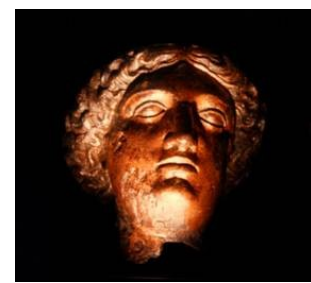
- Have run 2 calibration and reconstruction passes on first half of anti-neutrino run

- Have run calibration and reconstruction passes on several weeks of neutrino data

- Putting in details of optical model into simulation

- First Data/MC distributions shown at ICHEP
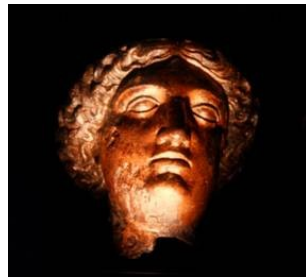 - 4.04×10^{19} in anti-neutrino mode
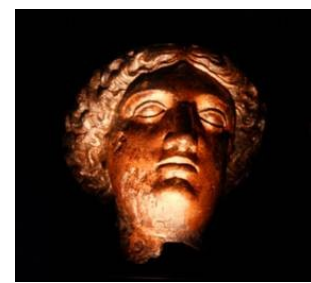 - Untuned neutrino flux

Summary

- MINERvA is accumulating a data set with great potential to illuminate complex phenomena in the nucleus
  - High statistics exclusive neutrino reactions
  - Range of different nuclei to see effects of the nuclear environment in weak interactions
- Next Presentations:
  - Ron Ransome: Exclusive Reactions
  - Eric Christy: Resonance Region Structure Functions and the transition to perturbative QCD
  - Jorge Morfin: Parton Distribution Functions of the Nucleon: Isolated and within the nucleus and the benefit of H_2/D_2 scattering at FNAL

Backup: Event Statistics in Anti-Neutrino Mode

- For comparison: 4E20 POT
- acceptance will also be worse because of missing proton track at vertex
- Total event comparison: factor of 3 in statistics, QE to QE truth ratio much worse in antineutrinos
- These are only the anti-neutrino events, neutrino contamination not shown

	ANY	CC	CCQE	CCQE truth	NC	CCCoh	NCCoh
Target							
1	54000	37000	13000	8000	16000	440	120
2	52000	35000	12000	8000	16000	300	170
3	47000	33000	11000	7000	14000	450	260
4	19000	13000	4000	2000	6000	100	40
5	25000	17000	6000	4000	7000	180	80
Tracker	630000	445000	153000	113000	185000	8400	4200
Total	827000	580000	199000	142000	244000	9900	4860